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(54) **APPARATUS AND PROCESS FOR OXYCOMBUSTION WITH CO2 CAPTURE**

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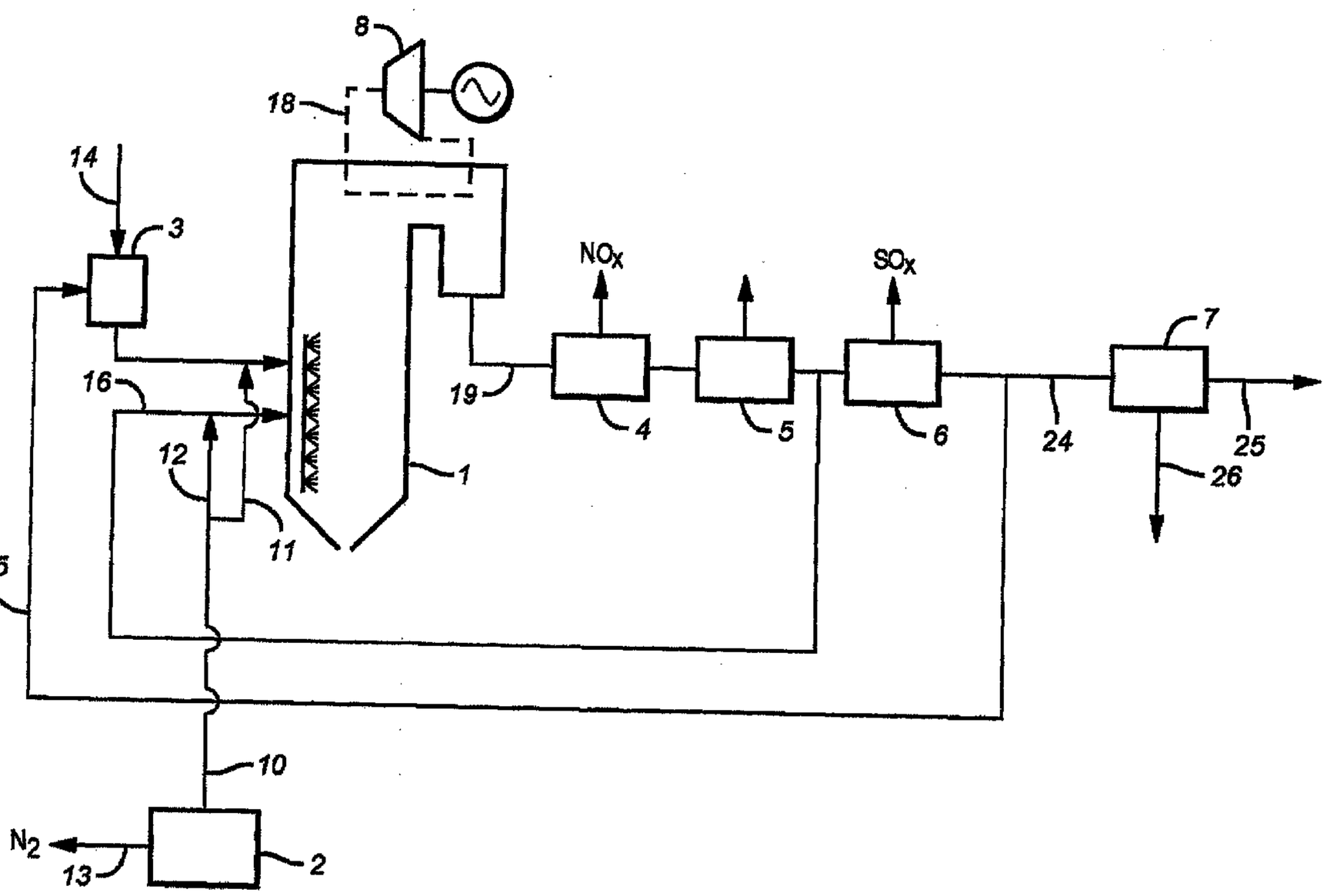
(57) **ABSTRACT**

An oxycombustion apparatus comprising an air separation unit (**2**) in which oxygen (**10**) is produced optionally by cryogenic distillation, an oxycombustion boiler (**1**), means for sending the oxygen and a fuel (**14**) to the oxycombustion boiler, means (**19**) for recovering carbon dioxide-containing flue gases from the oxycombustion boiler, and means (**7**) for purifying the flue gases in order to extract carbon dioxide therefrom, the air separation unit being provided for producing oxygen to be sent to the boiler having a purity not exceeding 95 mol %.



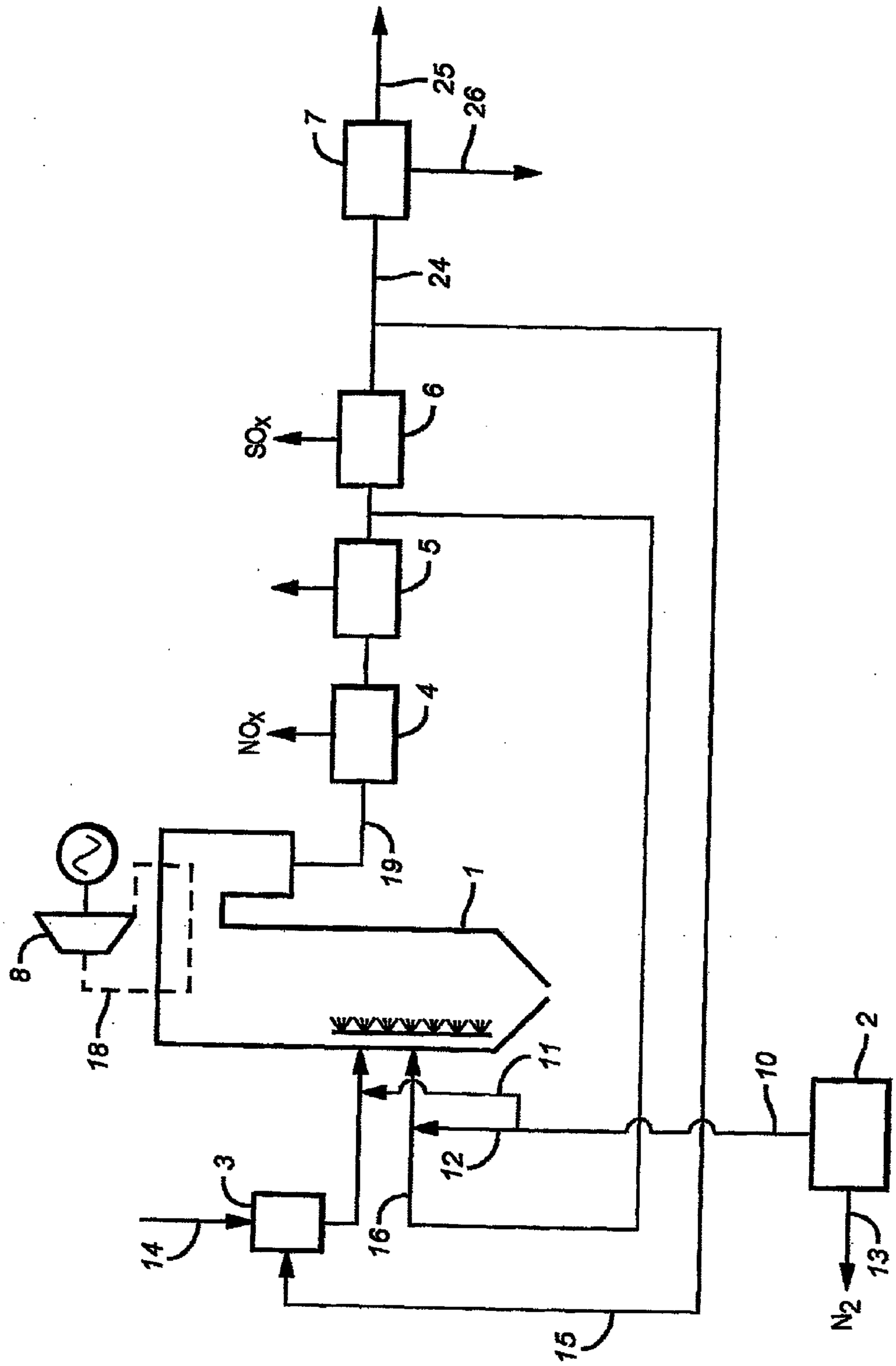


FIG. 1

APPARATUS AND PROCESS FOR OXYCOMBUSTION WITH CO2 CAPTURE

[0001] This application claims priority from FR 0852312 filed Apr. 7, 2008.

BACKGROUND

Field of Invention

[0002] The present invention relates to an apparatus and process for oxycombustion with carbon dioxide capture. The oxycombustion in a boiler serves to facilitate CO_2 capture.

[0003] The energy consumption of the air separation unit significantly encumbers the overall efficiency of the installation. In general, it represents nearly twice the consumption of CO_2 purification and compression, before sequestration.

[0004] It is proposed to reduce the overall energy consumption of the air separation unit (ASU) supplying the oxycombustion and of the CO_2 purification and compression unit (CO_2 CPU)

SUMMARY OF THE INVENTION

[0005] The invention consists in selecting a purity for the oxygen produced by the ASU that minimizes the overall consumption of the ASU and of the CO_2 CPU.

[0006] The invention consists in selecting a purity for the oxygen-rich product of the ASU that minimizes the overall ASU+CO_2 CPU consumption, while taking account of the air infiltration into the boiler (if applicable).

[0007] For example, in a conventional low pressure ASU configuration, of the type having two reboilers in the low pressure column and a CO_2 CPU based on a purification using two phase separators, up to 3% of purification using two phase separators, up to 3% of the energy (related to the ASU) can be saved by producing oxygen at 85 mol % instead of 95 mol %, which is the conventionally adopted value.

[0008] Also in a conventional low pressure ASU configuration, of the type using two reboilers in the low pressure column and a CO_2 CPU based on a purification using two phase separators and a distillation column with recycling of a pure or impure CO_2 fluid, up to 5% of the energy (related to the ASU) can be saved by producing oxygen at 75 mol % instead of 95 mol %.

[0009] Obviously, producing very impure oxygen means having more nitrogen in the boiler flue gases, which penalizes the CO_2 CPU portion in terms of size and energy, because of the higher flow rate to be treated.

[0010] Nevertheless, unexpectedly, when the relative weight of the CO_2 CPU in terms of energy and cost is compared to the ASU, it is advantageous to shift the operating point towards a more impure O_2 content (that is, lower than 95 mol %).

[0011] This is especially significant with a medium CO_2 yield target (between 85 and 95%).

[0012] According to one object of the invention, it relates to an oxycombustion apparatus comprising an air separation unit in which oxygen is produced optionally by cryogenic distillation, an oxycombustion boiler, means for sending the oxygen and a fuel to the oxycombustion boiler, means for recovering carbon dioxide-containing flue gases from the oxycombustion boiler, and means for purifying the flue gases in order to extract carbon dioxide therefrom, characterized in that the air separation unit is provided for producing oxygen to be sent to the boiler having a purity not exceeding 95 mol %.

[0013] According to other aspects of the invention:

[0014] the air separation unit is provided for producing oxygen to be sent to the boiler having a purity not exceeding 90 mol %,

[0015] the air separation unit is provided for producing oxygen to be sent to the boiler having a purity not exceeding 85 mol %,

[0016] the air separation unit is provided for producing oxygen to be sent to the boiler having a purity not exceeding 80 mol %,

[0017] the apparatus comprises a double or triple air separation column, means for sending the air to the column operating at the highest pressure, the column operating at the lowest pressure containing two condensers, i.e. a chamber condenser and an intermediate condenser.

[0018] According to another object of the invention, it relates to an oxycombustion process in which oxygen is produced optionally by cryogenic distillation in an air separation unit, the oxygen and a fuel are sent to an oxycombustion boiler, flue gases containing carbon dioxide are recovered from the oxycombustion boiler, and the flue gases are purified to extract carbon dioxide therefrom, characterized in that the air separation unit is provided for producing oxygen to be sent to the boiler having a purity not exceeding 95 mol %.

[0019] According to other aspects of the invention:

[0020] the air separation unit produces oxygen to be sent to the boiler having a purity not exceeding 90 mol %,

[0021] the air separation unit produces oxygen to be sent to the boiler having a purity not exceeding 85 mol %,

[0022] the air separation unit produces oxygen to be sent to the boiler having a purity not exceeding 80 mol %.

BRIEF DESCRIPTION OF DRAWING

[0023] FIG. **1** is a schematic view of an oxycombustion apparatus in accordance with one embodiment of the present invention.

[0024] The invention is described in greater detail with reference to the sole figure.

[0025] An air separation unit **2** produces an oxygen-rich stream **10** having a purity of 75 to 95 % and a waste nitrogen stream **13**. The oxygen-rich stream **10** is divided into two to form two sub-streams **11** and **12**. A recycle stream **15** is sent to the coal **14** spray unit **3**. The stream **11** is mixed with the recycle stream **15** downstream of the unit **3** and the mixture is sent to the burners of the boiler **1**. The stream **12** is mixed with a recycle stream **16** which supplies the burners. Water is sent to the boiler **1** to produce steam **18** to be expanded in the turbine **8**. The waste gas **19** consisting of the CO_2-rich oxycombustion flue gases, typically containing more than 70 mol % CO_2, passes through several treatments to remove the impurities. Its composition is typically (dry basis):

Ar:	2 to 3%
O_2:	3%
N_2:	1 to 25%
CO_2:	the remainder, not including SO*x*, NO*x* type impurities, etc.

[0026] These units may comprise a unit **4** for removing NOx, for example by reduction, a unit **5** for removing dust, for

example by filtration, a unit **6** for desulphurization to remove SO_2 and/or SO_3. The units **4** and **6** may not be necessary depending on the CO_2 purity required. The purified waste gas **24** is sent to the compression and purification unit **7** to produce a CO_2-rich stream containing more than 85% CO_2, or even more than 99% CO_2, which can be recovered, and a waste stream **26**.

[0027] The air separation unit **2** is preferably of the type comprising a double or triple air separation column with medium pressure column and low pressure column. The low pressure column comprises a chamber condenser and an intermediate condenser, the chamber condenser being heated by air or nitrogen and the intermediate condenser being heated by nitrogen. Such apparatus are known from EP-A-0538118 and U.S. Pat. No. 4,704,148.

1. Oxycombustion apparatus comprising an air separation unit (**2**), an oxycombustion boiler (**1**), means for sending the oxygen and a fuel (**14**) to the oxycombustion boiler, means for recovering carbon dioxide-containing flue gases (**19**) from the oxycombustion boiler, and means (**7**) for purifying the flue gases in order to extract carbon dioxide therefrom, characterized in that the air separation unit is provided for producing oxygen to be sent to the boiler having a purity not exceeding 95 mol %.

2. Apparatus according to claim **1**, in which the oxygen produced by the air separation unit is by cryogenic distillation.

3. Apparatus according to claim **1**, in which the air separation unit (**2**) is provided for producing oxygen to be sent to the boiler (**1**) having a purity not exceeding 90 mol %.

4. Apparatus according to claim **3**, in which the air separation unit (**2**) is provided for producing oxygen to be sent to the boiler (**1**) having a purity not exceeding 85 mol %.

5. Apparatus according to claim **4**, in which the air separation unit (**2**) is provided for producing oxygen to be sent to the boiler (**1**) having a purity not exceeding 80 mol %.

6. Apparatus according to claim **1** comprising a double or triple air separation column, means for sending the air to the column operating at the highest pressure, the column operating at the lowest pressure containing two condensers, i.e. a chamber condenser and an intermediate condenser.

7. Oxycombustion process in which oxygen and a fuel (**14**) are sent to an oxycombustion boiler (**1**), flue gases (**19**) containing carbon dioxide are recovered from the oxycombustion boiler, and the flue gases are purified to extract carbon dioxide therefrom, wherein an air separation unit is provided for producing oxygen to be sent to the boiler having a purity not exceeding 95 mol %.

8. Process according to claim **7**, in which the oxygen is produced by cryogenic distillation in an air separation unit.

9. Process according to claim **7**, in which the air separation unit (**2**) produces oxygen to be sent to the boiler (**1**) having a purity not exceeding 90 mol %.

10. Process according to claim **9**, in which the air separation unit (**2**) produces oxygen to be sent to the boiler (**1**) having a purity not exceeding 85 mol %.

11. Process according to claim **10**, in which the air separation unit (**2**) produces oxygen to be sent to the boiler (**1**) having a purity not exceeding 80 mol %.

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